REMARKS

By way of the present response, claims 1-7, 9, 11-19, 22-26, 29, 31, 33, 34 and 27 are amended. Support for the amendments can be found, for example, in page 72, line 1 to page 73, line 12 and in Fig. 12; the method described page 45, line 17 to page 47, line 17 and equation (3); in model diagrams and the description, such as described in page 79, line 10 to page 85, line 2 and equation (21); in the cylinder volume (estimated accumulation observation quantity) shown in Fig. 17; in page 87, line 23 to page 91, line 16 and equations (28) and (31); and in estimated angular velocity as shown in Fig. 21. Claims 1-37 currently are pending. Reconsideration and withdrawal of the rejections of the claims is respectfully requested in view of the above amendments and the remarks advanced below.

Before proceeding with an analysis of the rejections, it is to be noted that while the "Office Action Summary" (i.e., page 1 of the Office Action) indicates claims 30-32 are rejected, the Action contains no grounds of rejection with respect to these claims. Absent any grounds of rejection for claims 30-32, Applicant respectfully submits that these claims are allowable.

In the most recent Office Action, claims 1, 23, 29 and 37 are rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite. The Examiner continues to assert the term "estimated observation quantity," as recited in claims 1, 23, 29 and 37, is not clear, that an estimated quantity and observation are different, and that a different unit is required to estimate a quantity or to perform an observation process to reproduce the estimated observation quantity. However, Applicant addressed this rejection in the prior response of June 23, 2005. Nevertheless, it appears the Examiner continues to mistakenly assert that an "estimated observation quantity," as recited in the claims and defined in Applicant's disclosure, represents a measured value. To render the claims abundantly clear, Applicant has replaced this term in all claims in which it is recited with "estimated state quantity." It is respectfully submitted that this feature, as recited in the context of the claims and as described in the specification, is definite and fully compliant with the requirements of Section 112, second paragraph.

Also with respect to claim 1, the Examiner objected to the features of "divided or differentiated with an absolute value." However, this language is not found in claim 1, but instead is recited in claim 4. Applicant has amended this claim recite that "the estimation value is ... multiplied or divided with an absolute value of the estimated state quantity."

With respect to the remaining objections, claim 23 is asserted to be unclear with

respect to what the logical decision function does and that for the cited feature "impossible state." The Examiner asks, "What is the impossible state? Does it relate to an uncontrollable state? Why impossible state need for control." (See, page 3, lines 7-9.) However, these questions were set forth in the previous Office Action, and Applicant has responded thereto starting at line 28 of page 19 to line 22 of page 29, as follows:

> With respect to claim 23, the Examiner asserts that the recited "estimation observation quantity" is unclear for what the logical function does. The Examiner also required that a specific function for the logical decision unit be recited. As mentioned above, however, it is axiomatic that claims are to be read in light of the specification, not in a vacuum. Furthermore, the Examiner here appears to be improperly equating the breadth of the recited features with indefiniteness. This is further evident in the Examiner's statements, "The cited feature "impossible state" in the claim made the claim unclear for what it claims for. What is the impossible state? Does it relate to an uncontrollable state? Why impossible state need for control." (See, page 4, lines 3-6.) The Examiner's attention is respectfully directed to page 132, line 2 to page 133, line 16, Figures 47 and 48, and page 108, line 1 to page 114, line 14 and Figure 33, which describes an example in which a relative movement possible state is a state where two members move with connected state, while a relative movement impossible state is a state where two members move independent of each other.
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> In response to the Examiner's question "why impossible state need for control," in the preset invention, the relative movement possible state and the relative movement impossible state are reproduced equally because to reproduce the dynamic behavior of parts or the like (e.g., see page 171, line 4 to page 172, line 12).
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> With respect to the Examiner's statements concerning the specific function for the logical decision unit, in the exemplary example mentioned above, in order to reproduce behavior of the relative movement possible state and the relative movement impossible state of the above described exemplary two members, the logical decision unit decides connection state (i.e., relative movement possible state) and disconnection state (i.e., relative movement impossible state) while estimating both positions, from the integrated value of relative speed between two members (e.g., see page 132, line 2 to page 133, line 16 and Figures 47 and 48), or integrated value of an angular velocity of a principal part (e.g., see Figure 33), for example. The application also describes an exemplary function of a logical decision unit (e.g., see page 132, line 2 to page 133, line 16 and Figures 47 and 48).

The minor typographical informality in claim 37 noted by the Examiner has been corrected.

For the foregoing reasons, it is believed all pending claims fully comply with Section 112, second paragraph. As such, this rejection should be withdrawn.

Starting on page 4, claims 1-28 and 33-36 are rejected under 35 U.S.C. § 102(e), as allegedly being anticipated by Barford et al. (U.S. Patent No. 6,850,871). The rejection is

respectfully traversed.

The present invention is fundamentally different from the method and apparatus described in the Barford et al. patent for several reasons:

First, one aspect of the present invention is to provide a physical model for faithfully reproducing a behavior of a product or component having a non-linear characteristic. In contrast, the cited reference Barford et al. aims to obtain a black box model for reproducing a non-linear behavior (entity) by curve fitting the parameter of a multivariable polynomial based on measured data from an entity. Therefore, Barford shows that measured data obtained by a measuring instrument suitable for an entity can be developed into each physical system.

Second, Barford et al. discloses, with reference to Figs. 1 and 2, a method in which data output from an entity to which input is given (101) is measured (102-103, 103a), the parameter value of a polynomial (black box model) is estimated by the curve-fitting, and processing is repeated (101-106) until a calculation error of the polynomial function falls within an acceptable range (106). On the other hand, the apparatus of the present invention uses the *first and second state quantities and parameter within a model*, and therefore requires no entity measurement.

Third, in terms of model, the present invention discloses an apparatus and method for formulating a physical model for each field, whereas what is disclosed in Barford is the application of a non-physical model (i.e., a black box model), which is obtained by curve-fitting one type of generic function with measured data, to each field. In addition, in terms of how to obtain a parameter for reproducing non-linearity, the present invention obtains a model parameter by *directly calculating it based on the state quantity and parameter within the model*. In contrast, Barford et al. obtains a parameter by measuring data while changing input to an entity, and by repeating the processing until a curve-fitting error falls within an acceptable range, which is a general method applied to an apparatus.

Turning now to independent claim 1, Applicant respectfully submits that the Barford et al. patent fails to describe each and every claimed limitation, and therefore fails to anticipate claim 1. For instance, Barford et al. does not disclose "a state quantity transformation unit for linear-transforming the first state quantity to the second state quantity every sampling time in accordance with a transformation parameter …."

In setting forth the rejection of claim 1, the Examiner appears to consider the

nonlinear device (a target of measurement) shown in Fig. 2 of Barford et al. to correspond to the claimed "state quantity transformation unit," and the generic function in the block 214 as a behavioral model of the non-linear device (see Barford et al., column 12, lines 24-43) to correspond to the claimed "non-linear characteristic reproducing apparatus." From these correspondences, however, it is clear that the "state quantity transformation unit" for performing linear transformation of the present invention is quite different from the device (entity) of Barford et al. serving as a target of measurement.

First, Barford et al. uses measured data (col. 12, lines 24-43, Fig. 2) from an entity (device) for model parameter transformation. In contrast, the present invention uses the *first and second state quantities within a model* (as shown in all examples). Therefore, the source from which data is obtained for transforming a model parameter in Barford et al. is fundamentally different from that of the present invention.

Second, Barford et al. discloses a non-linear model formulating method for reproducing a behavior of a measured entity by curve-fitting a generic function (i.e., a black box model) such as a physically meaningless polynomial with data obtained by measuring the entity (device) having a non-linear characteristic (e.g., see Barford et al., column 21, line 35 to column 22, line 43; column 8, line 62 to col. 10, line 20). In contrast, the present invention is directed to an apparatus for reproducing a behavior of an entity by obtaining a non-linear parameter through calculation using *state quantities and parameter within a model* and giving the obtained parameter to the state quantity transformation unit that performs linear transformation. Therefore, the present invention does not require a device for reproducing a non-linearity (e.g., a black box model) and no actual entity, as well as measured data from the entity, as disclosed in Barford et al. Additionally, the present invention is an apparatus for formulating a physical model unlike Barford et al. (Barford et al. is not a physical model, which is apparent from column 27, line 30). Incidentally, all the examples disclosed in the present invention show that the present invention is a physical model for reproducing a physical property of an entity.

Third, Barford et al. requires, as shown in Fig. 1, measurement of an entity (103 etc.), curve-fitting (105), processing for determining calculation error of output value from model (106), convergence processing of repeating each step in Fig. 1 until the calculation error falls within an acceptable range. The present invention, by contrast, reproduces a non-linear characteristic in a process that involves giving a non-linear parameter obtained from the *first*

and second state quantities within a model to the state quantity transformation unit that linear-performs the received parameter, which is significantly and fundamentally different from Barford et al.

Fourth, Barford et al. discloses a sampling means for performing data sampling used by a measuring means such as ADC for converting analog data from an entity (device) into digital data (see, columns 12 to 13), DAC (see, column 23, lines 24-67), or the like. This is completely different from something needed to sample calculation for obtaining a non-linear parameter from the *first and second state quantities* and giving the obtained parameter to the state quantity transformation unit, as recited in claim 1.

Finally, estimated data (estimated observation quantity) of Barford et al. is a result from a calculation of a function curve-fitted with measured value, which is used to determine an error of the measured value and the calculation of function (see, column 9 line 51 to column 11, line 36). This is different from the estimated observation quantity used to determine a parameter of the present invention. See, for example, page 79, line 10 to page 85, line 2 and equation (21).

Claims 2-14 depend either directly or indirectly from claim 1 and are therefore allowable for at least the above reasons, and further for the additional features recited.

For instance, claim 2 recites that "said non-linear characteristic reproducing unit receives the estimated state quantity and one or more external operation variables as well, and determines the transformation parameter in accordance with the estimated state quantity and one or more variables thus received." The estimated observation quantity and parameter of the present invention are directly obtained from the first and second state quantities and parameter included in a model, and therefore the way of obtaining the estimated observation quantity and parameter is different from that of Barford et al. This distinction recited in claim 2 is apparent from the fact that the state quantity and parameter within a model are applied to every example of the present invention and that they are physical properties (quantities). See, for example, page 79, line 10 to page 85, line 2 and equation (21).

In contrast, Barford et al. discloses a means for receiving estimated observation quantity and parameter (see, columns 18 to 23), which is shown as a method (column 20) of curve-fitting a generic function such as polynomial (column 9, line 35) using measured value and repeating a convergence calculation until the validity is established. Specifically, Barford et al. discloses that the parameter value of a generic function curve-fitted by the

value of measured output data from an entity is determined (columns 18 to 23) and the generic function is repeated until the statistical validity is established to obtain an estimated observation quantity (column 24, line 56 to column 25, line 20). Further, column 27, line 30 in Barford et al. shows that the generic function model of Barford et al. is more precise than physical models, i.e. the model of Barford et al. is a function model and its parameter is a value of the function having no physical meaning.

As for the step of determining a parameter, refer to the distinctions pointed out above with respect to claim 1.

Claim 3 recites that "said non-linear characteristic reproducing unit determines in form of the transformation parameter a normalized estimation value in which an estimation value of the second state quantity at the subsequent sampling time is normalized with the estimated state quantity." Barford et al. fails to disclose normalization of an estimation value by an estimated state value. In connection with normalization, Barford et al. describes standards of electronic devices such as DAC and ADC built in a reference signal generator (202) for exciting signals based on an entity and a data acquisition system (206) (see, column 23, lines 24-67). According to Barford et al., generally known techniques can be employed as these devices and adjustment method (see col. 11, line 43 – col. 12, line 24, col. 23, lines 24-31). However, the features recited in claim 3 have nothing to do with normalization of a device or adjustment method, but instead determine a parameter in a model such that a normalized output state quantity can be obtained (e.g., see page 173, line 22 to page 176, line 7, equations (94) and (98), and Fig. 70). This is fundamentally different from Barford et al.

Claim 4 recites subject matter directed to obtaining a non-linear model parameter from which an influence of the positive/negative sign of the first state quantity is removed. This is apparent from the specification, specifically: integration of absolute value in page 43, line 4 to page 45, line 15, Fig. 1, in equation (2); and division of absolute value in page 45, line 17 to page 48, line 6, Fig. 2, equations (3) and (5). In contrast, Barford et al. discloses a solution for determining an eigenvector and an eigenvalue based on a matrix used to curve-fit a generic function such as multivariable polynomial (see, column 22).

As shown in equations (2), (3) and (5), a feature recited in claim 4 is to calculate a parameter directly from the first and second state quantities, which is quite different from the way of obtaining values by solving a state space matrix as disclosed in the Barford et al. patent. Incidentally, the state space matrix includes inner state quantity in addition to

input/output state quantity, which cannot be solved by the feature recited in claim 4 of the present invention.

With respect to claims 5-14, the Examiner cites more than one reference portions of Barford et al. and the statement of the rejection is abstract. Therefore, included below is a summary of the contents of Barford et al. including the cited portions and Applicant's comments concerning these parts relied upon:

1) Barford et al., at column 2, suggests that the apparatus can be applied to a vehicle (mechanical and hydraulic devices) based on driver inputs and vehicle response. However, no specific method therefore is suggested.

2) Barford et al., column 12, fails to disclose a dynamic system like those disclosed in the present invention. This cited portion suggests that various systems can be employed by curve-fitting the function when a reference signal generator (202) for exciting signals based on an entity and a device with system for obtaining response output data (206) are selected according to the entity so that data can be obtained by using the selected devices.

3) Barford et al., at column 18, suggests that the application to a vehicle (mechanical and hydraulic devices) is possible if a reference signal generator (202) and a device with system for obtaining response output data (206) suitable for the operation and movement of each vehicle element are selected, like the above col. 12. In addition, column 18 describes points to note as to filtering processing for removing noise from measured data.

4) The model of Barford et al. is a black box model requiring no physical knowledge, which is clearly shown in column 6, lines 44-54. Therefore, Barford et al. does not formulate a model (function) for each physical system and merely applies a black box model to each physical system.

The cited portions of Barford et al. disclose that as long as measuring devices {102 and 103) for measuring input from an entity and for measuring response output are selected according to the entity, a black box model obtained by curve-fitting a generic function such as multivariable polynomial (105) can be applied to a system of each field.

As the Examiner can readily appreciate, the present invention and Barford et al. are fundamentally different as shown below in terms of application to each system. Barford et al. applies a common generic function model, which serves as a black box model with no physical meaning, to systems of various fields, whereas the present invention formulates a physical model (equation) for a system of each field. Therefore, the present invention and

Barford et al. are quite different in model and formulation method. Furthermore, Barford et al. obtains a model parameter based on a result of curve-fitting in which input/output data obtained from en entity via measuring devices is given to a generic function, whereas the present invention obtains a model parameter directly from state quantities and parameter included in a model. Therefore, the present invention and Barford et al. are quite different in structure of model for reproducing a system of each field.

Similar distinctions are set forth in claim 15, and hence this claim is believed allowable for reasons analogous to those above for claim 1. For instance, claim 15 recites that a non-linear characteristic reproducing apparatus comprises a linear model unit for reproducing characteristics of a linear system, <u>and a non-linear model unit for determining, upon receipt of an estimated state quantity at a subsequent sampling time of at least one state quantity of a first state quantity and a second state quantity, which are in a relation of mutually non-linear transformation, or a state quantity derived from said one state quantity, from said linear model unit, a transformation parameter used for a linear transformation at the subsequent sampling time between the first state quantity and the second state quantity</u> ...." In rejecting these features of claim 15, the Examiner refers to the same parts from Barford et al. (i.e., columns 12-14, column 17, line 57 to column 23, line 22) as was applied in rejecting claim 1. As pointed out above, however, Barford et al. uses <u>measured data</u> from an entity (device) for model parameter transformation. In contrast, the present invention uses the *first and second state quantities and parameter within a model.* For at least this reason, and other reasons analogous to those pointed out above with respect to claim 1, the invention recited in claim 15 is considered fundamentally different from that of the Barford et al. patent.

Also, claims 16-18 depend from claim 15 and are therefore allowable over Barford et al. at least for the above reasons. Furthermore, these dependent claims recite additional features defining further points of distinction.

For example, claim 16 recites "non-linear model unit has a plurality of non-linear transformation units for determining, upon receipt of an <u>estimated state quantity</u> at a subsequent sampling time of at least one state quantity of a first state quantity and a second state quantity, which are in a relation of mutually non-linear transformation and at least one of which is different in type, or a state quantity derived from said one state quantity, a transformation parameter used for a linear transformation at the subsequent sampling time between the first state quantity and the second state quantity." The estimated state quantity

and parameter of the present invention are obtained from the first and second state quantities and parameter included in a model, and therefore the way of obtaining the estimated observation quantity and parameter is different from that of Barford et al. See the reasons given above with respect to claim 2.

As for the step of determining a parameter, refer to the distinctions pointed out above with respect to claim 1.

With respect to claims 17, 18 and 21-26, the Examiner does not cite any section from Barford et al. relied upon for meeting the combinations of features respectively recited. Applicant submits that Barford et al. is silent to these combinations, and the Examiner attention is directed to the summary provided above in connection with claims 5-14.

Claim 19 recites subject matter defining distinctions similar to those pointed out with respect to claim 1, and are therefore allowable for analogous reasons. In addition, as discussed in the above comments on claim 1, processing for error determination (106) of Barford et al. determines an error based on the calculated estimation value of a curve-fitted function and the measured value of an entity and makes calculation estimated values converge by determining whether repeating the calculation is necessary or not based on the error. This is substantially different from the logical decision unit recited in claim 19 for performing model behavior switching (see page 171, line 4 to page 172, line 22, page 132, line 2 to page 113, line 16, and the switch element in Fig. 48).

Claims 20-26 depend from claim 19 and are therefore allowable at least for the above reasons, and further for the additional features recited.

For example, claim 20 recites "said state quantity selecting unit outputs at the subsequent sampling time an output state quantity in which a relation between the input state quantity and the output state quantity is changed over to a connection relation according to the logical value at the subsequent sampling time determined by said logical decision unit." It is respectfully submitted that contrary to the bald allegation made on page 7 of the Action, Barford et al. fails to disclose these features. As described above, Barford et al. employs a black box model in which a generic function is curve-fitted with data from entity. On the other hand, the present invention formulates each model (equation) based on state quantities and parameter included in model. Therefore, the model of the present invention is substantially different from that of Barford et al. and accordingly Barford et al. fails to disclose the feature of claim 19.

Furthermore, the unsupported allegation on page 7 of the Action that Barford et al. anticipates the features of claims 21-26 does not meet the requirements of establishing a *prima facie* case of anticipation, not only because all claimed features of independent claim 19 are not shown, but also the additional features recited in these dependent claims. Again, the Examiner's attention is directed to the summary provided above with respect to claims 5-14.

In rejecting claims 27 and 33-36, the Examiner cites the same parts from Barford et al. as in the statements of the rejection of claims 1, 15 and 19, and merely regurgitates some of the claim language with no explanation of how he is interpreting the Barford et al. patent to meet the combinations of specific features recited in each of these claims. Applicant submits that Barford et al. does <u>not</u> disclose the combinations of features recited, and thus fails to anticipate claims 27, 28 and 33-36. As pointed out above with respect to claim 1, Barford et al. is conceptually and fundamentally different from the present invention. The Examiner is respectfully requested to explain in detail with citations to particular line numbers for each feature, and explanation where any explicit disclosure in Barford et al. of recited features are absent, where the Barford et al. patent describes each and every feature recited in claims 27 and 33-36, in the next communication to Applicant.

Additionally, as to the details of the feature recited in claim 27, Barford et al. in column 24, line 36 et seq. discloses that order etc. of a generic function or equation to be curve-fitted is selected (see Fig. 10 where a user makes a selection on a dialog box). On the other hand, as shown in page 171, line 4 to page 172, line 22, Figs. 65, 66 and 67, what recited in claim 27 is a feature in which stability of a model is determined based on the progress of sampling time and an output state quantity is selected to stabilize a system, which is <u>substantially different</u> from Barford et al.

With respect to dependent claim 28, what disclosed in columns 12-15 of Barford et al. is to determine an error based on the measured value from entity and the estimated value from curve-fitted function (calculation result), which is quite different from the present invention.

Independent Claims 33 to 36 each recite similar distinctions as pointed out above for claim 1. As such, these claims are considered patentable.

The remaining claims are patentable by virtue of their dependence from one of the allowable independent claims discussed above, and further for the additional features recited.

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All rejections raised in the Office Action having been addressed, it is respectfully submitted that the present application is in condition for allowance and notice of allowance is earnestly solicited.

Respectfully submitted,

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